Exhibit 7
to Declaration of Rachel Doughty

Greg Allord
Summary of Written Testimony

SOS EXHIBIT 295

http://nationalmap.usgs.gov/historical

SOS 295 002

Summary of Opinion

Mr. Nicholls testified that the hydrologic features on the 1905 Map (PT-312/SOS 091) were not reliable. (BTB-38_001) He based his opinion on:

1. The mapping objectives for the 1905 Map (BTB-38_001:20, 001, n.2)
2. Mapping practices he believed were employed in development of the 1905 Map (BTB-38_002, n. 3)
3. Mapping technology available in 1905 (BTB-38_002, n. 3)
4. Georeferencing performed by someone in Mr. Nicolls' office (BTB -38_003-007; see also, BTB-39)
5. Apparent misalignment of streams and stream channels in the 1905 Map (BTB-38_007:10-15)

In my professional opinion, Mr. Nicholls' conclusions (BTB-38_007:18-008:24) are not supported by the evidence he provides or what is known about historical mapping practices by the USGS.

Purpose of Early USGS Topographic Maps

Purpose of Topographic Mapping Late 1800s, early 1900s

Topographic mapping was carried out over extensive areas in anticipation of future geological survey. The accuracy and immediate usefulness of topographic maps gave them an importance independent of their use as a base for geologic mapping. The 1888 Congress recognized this through specific appropriation for topographic work. Based on percentage of expenditures, topographic mapping was the major activity of the USGS in the early 1890's.[42]

SOS 301_008 (Phillips)

The primary purpose for which the geographic base is constructed is the representation of the areal geology of the country, and the map is accordingly constructed on such scales and represents such geographic features as are important to the geologist; but while in its construction the primary purpose of the map is thus considered, it is constantly borne in mind that it will inevitably be made to subserve other important ends. When drawn and engraved the plate will serve for new editions from time to time, which may be used for a great variety of purposes, some of which are subsidiary to or indirectly connected with geology, and some of which are independent of its requirements; e. g., in the study of drainage systems; in the study of the regimen of rivers; in the study of the great and growing subject of irrigation; in the study of the distribution forests; in the study of Artesian wells and basins; in the study of catchment areas for the supply of water to cities; in the study of drainage of swamps and lands subject to inundation; in the study of soils and the classification of land for agricultural purposes; in the study of the relations of rainfall and climate to topography; in the study of geographic and hypsometric distribution of organisms; in the study of the vestiges of pre-historic man; in the study of the distribution of existing and decadent races, and their relations to the natural features of the earth; in the laying out of railways, highways, and canals; and for many other purposes of which some only are now recognized while some will be developed with future progess. The users of topographic maps are many, but the geologist is the most exacting in his demands; and if properly made to meet his wants they will serve the purposes of the naturalist, the civil engineer, the agriculturist, the military engineer, and other users of accurate maps. It is believed that the topographic survey inaugurated and the topographic maps contemplated by the United States Geological Survey will meet the wants of all classes of people.

SOS 297_005 (Berlin)

SOS 295 005

Powell was called back early in January 1885 to elaborate on this testimony, and told the Allison Commission that he was unable to state any useful purpose which the cadastral or artificial element in the coast charts subserved first because it was not executed so as to form a complete cadastral map and second because the artificial topographic features were ephemeral and changed from year to year in such a manner that the charts speedily became misleading. The topographic maps made by the Geological Survey, on the other hand, represented natural features, such as streams and bodies of water, valleys, hills, and mountains and showed only certain cultural features such as important highways, canals, railroads, and wagonroads, the sites of cities, towns, villages, and railway stations. The purposes served by such topographic maps were many. They were used first of all as bases for geologic maps. They could be used for the purposes of the Signal Service and for all purposes of military maps except battle maps. They were valuable to cities and towns in securing a proper supply of water. As the maps were constructed with grade curves and every elevation and depression was represented "with mathematic accuracy," they could be used in laying out the courses of aqueducts and in planning and protecting waterworks so that the catchment areas would not be "corrupted by foul and pestilential agencies." The maps showed the relative levels of all parts of the country to each other and to the level of mean tide, so they could be used to determine the possibility and practicability of draining marsh- and swamplands. They were useful in planning and laying out highways, such as wagonroads, canals, and railroads. In conjunction with geologic maps, they could be used for determining the sites of artesian wells. The topographic maps were of the highest importance in areas where agriculture was dependent on artificial irrigation and streams had to be conducted from their natural channels by canals. As an illustration, he said that every town in Utah had been moved, perhaps twice on an average, after it had been built, when it was found that the water could not be economically brought to it or economically controlled. The studies that he had made of topographic methods and of the economics of topographic surveys grew out of his interest in these arid lands,

SOS 293_116 (Rabbitt)

A Purpose of the Early USGS Topo Maps Was Accurate Representation of Hydrologic Features

Mapping Practices & Technology

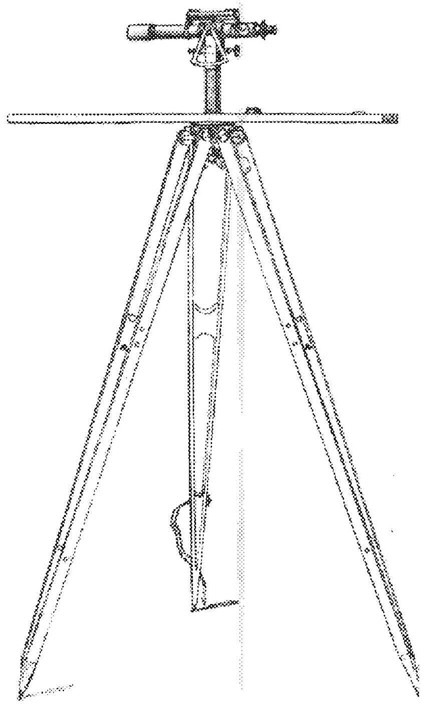
SOS EXHIBIT 295

The Geological Survey expanded its special investigations in 1897. The surveying of the Idaho-Montana boundary line was not an assignment for the timid. The transit used was provided with a compass attachment, fixed stadia wires, and a tripod with extensions legs. The last, R. U. Goode noted laconically, were at times very necessary, as may be seen from the plate. (From R. U. Goode, 1900.)

SOS 293_279 (Rabbitt)

SOS 295 008

Creating Maps was an Intense, Exhaustive, and Highly Accurate Process



Survey topographers needed a plane table that had the utmost stability consistent with lightness and portability for traverse work. Both forms used by the Coast and Geodetic Survey—a very stable but heavy and cumbersome movement and a light but unstable movement—were tried, but one invented by W. D. Johnson of the Survey that had a movement based on the ball-and-socket principle, proved more suitable. (From Henry Gannett, 1893.)

SOS 293_143 (Rabbitt)

Figure 3. The Berger theodolite was a precision instrument used for measuring horizontal and vertical angles. Manufactured by C.L. Berger & Sons, Boston (circa 1901).

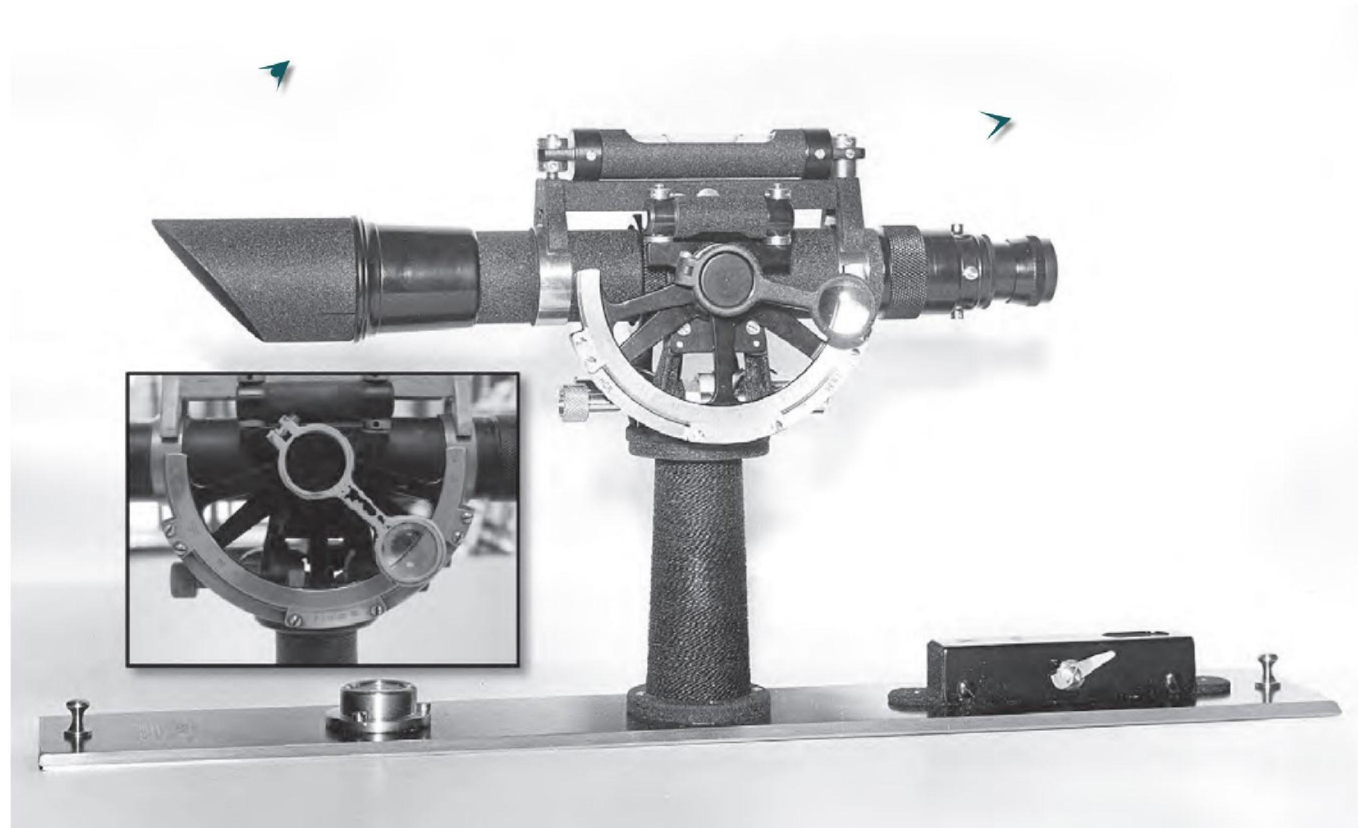


Figure 18. A Keiffel & Esser high standard alidade was used in conjunction with a plane table. The inset shows detail of W.M. Beaman's (U.S. Geological Survey topographer) improvement to the instrument, the Beaman Arc.

SOS 296_004 (Circular 1341)

SOS 296_008 (Circular 1341)

In Field "Sketching" Served as Quality Control

This, being by far the most important part of the work of map making, should be done by the most competent man for this work in the party—as a rule, by its chief. Besides the fact that he is presumably the best sketcher in the party, there is another reason for requiring that he should execute the sketching. He is held responsible for the quality of the work, not only of the sketching, but also of the accuracy and the sufficiency of the control. In the sketching of the map he has the best possible opportunity for examining into the condition of the control and of remedying any weaknesses.

Upon the completion of the secondary triangulation, the traverse work, and the measurement of heights within an area, which may be large or small according to convenience—but preferably should comprise a quarter sheet—he should cause all this control to be assembled upon one sheet. The traverse lines with all points located from them should be adjusted to the secondary locations, and all measurements of height should be plotted upon this skeleton, thus presenting in complete form all the control within the area. With this sheet upon a sketching board the chief of party should go over the ground, sketching the drainage, culture, and forms of relief. The latter should be sketched in actual continuous contours, direct from the country as copy, so that upon leaving the sketching stations the only work remaining to complete the map will be inking and lettering.

SOS 294_146 (Monograph 22)

U.S. Geological Survey (USGS) topographic mapping crew at camp in the Cascade Mountains of Washington. USGS photograph by A.E. Murlin, January 1, 1903.

SOS 292_003 (USGS Fact Sheet)

Figure 6. A U.S. Geological Survey pack train carries men and equipment up a steep slope while mapping the Mount Goddard, California, Quadrangle (circa 1907).

SOS 295 010

SOS 292_005 (USGS Fact Sheet)

1905 Map Created as part of Irrigation Study approved October 2, 1888, with special instructions from Major Powell

Though the topographic surveys were to be conducted generally as during preceding years, Major Powell had the fo lowing instructions distributed to party chiefs:

Maps.—All field work for the general map to be sketch on planetables on a scale of 1 inch to 1 mile, and in contours having a vertical interval of 100 feet in high mountains, 50 feet in the lower or less rough country, and 20 feet in all areas of possible irrigable lands or sites of possible reservoir A larger scale and smaller contour interval might be used for special maps.

The work being in a sparsely settled or entirely uninhabited region, it was necessary for the parties to subsist in camps. The organization for this purpose was nearly the same in all localities. The means of transportation was usually one large four-mule wagon for camp equipage and supplies, and buckboards or saddle animals for the persons engaged in the map work.

Usually each party employed, in addition to the regularly appointed assistants, one or two persons as traversemen or rodmen to assist in the field work. One cook, one teamster, and one laborer usually furnished sufficient force for camp duties.

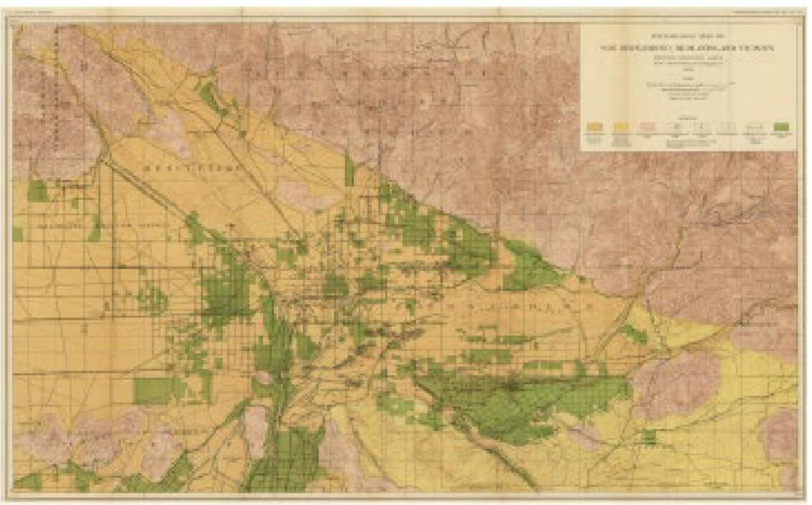
Horizontal Control.—To be secured by primary triangulation, secondary triangulation, planetable intersections and sketches, and planetable traverses between located points. Primary triangulation to be executed with accurate instruments, and at least two stations should be located on each quadrangle. All roads, streams, and important topographic features must be traversed and sketched by planetable methods.

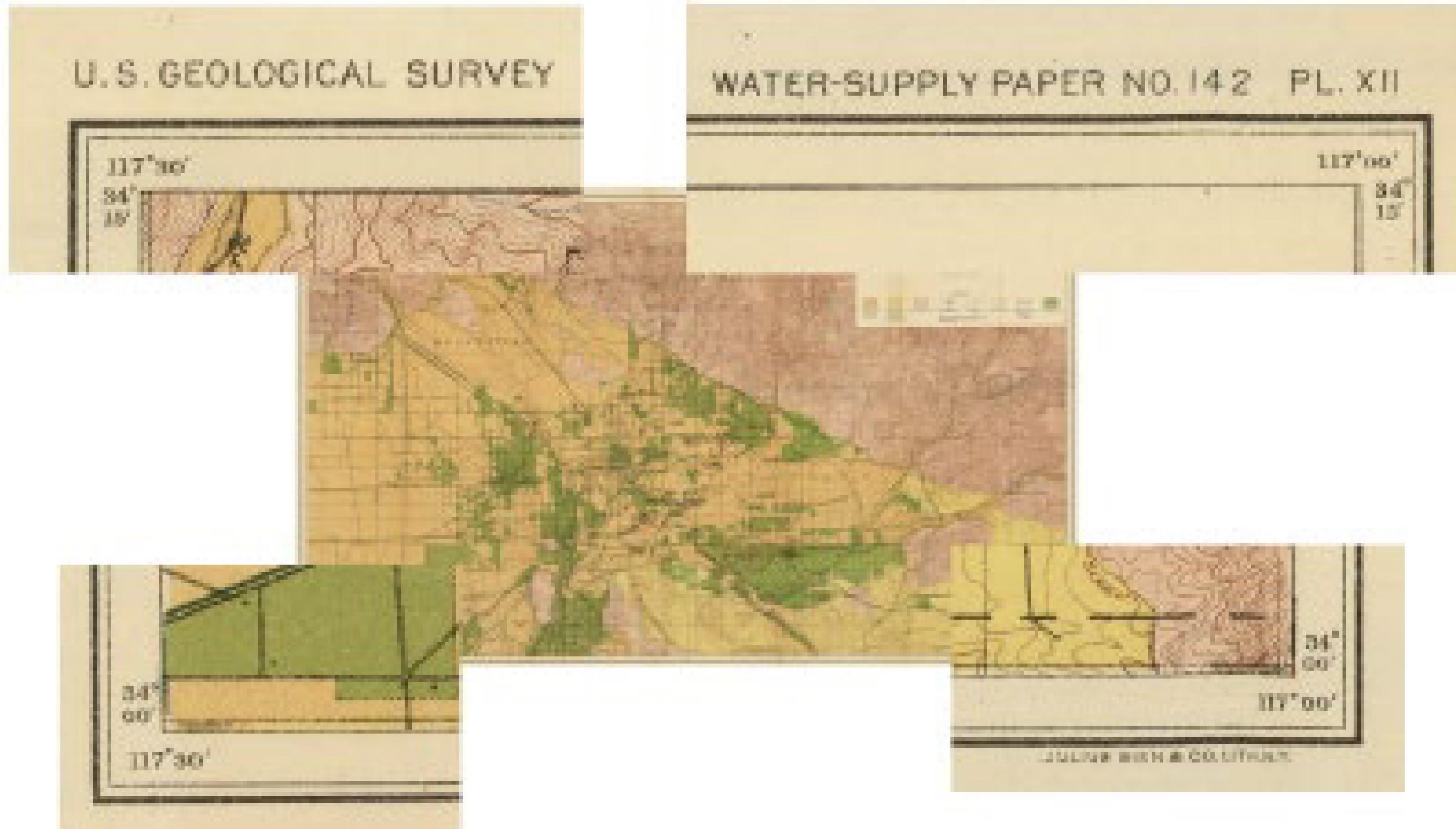
Vertical Control.—One or more points on each quadrangle to be accurately determined in altitude and used as primary reference, or bench marks, for the area, the "Y" spirit level to be used in determining the gradients of streams, reservoirs sites, etc. Gradienters and altitudes might be used in angular leveling, aneroid and mercurial barometers in traversing.

The 1905 Map
PT-312/SOS 091

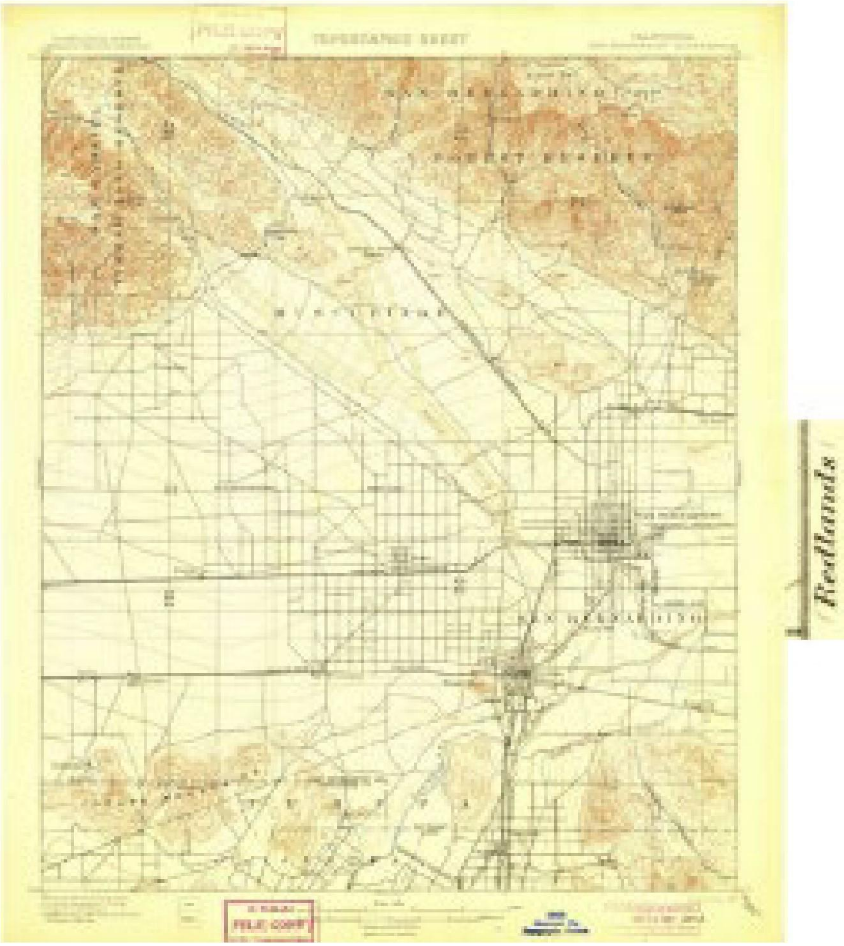
Geographic Extent of Plate 12, WSP 142, *The Hydrology of the San Bernardino Valley, California*

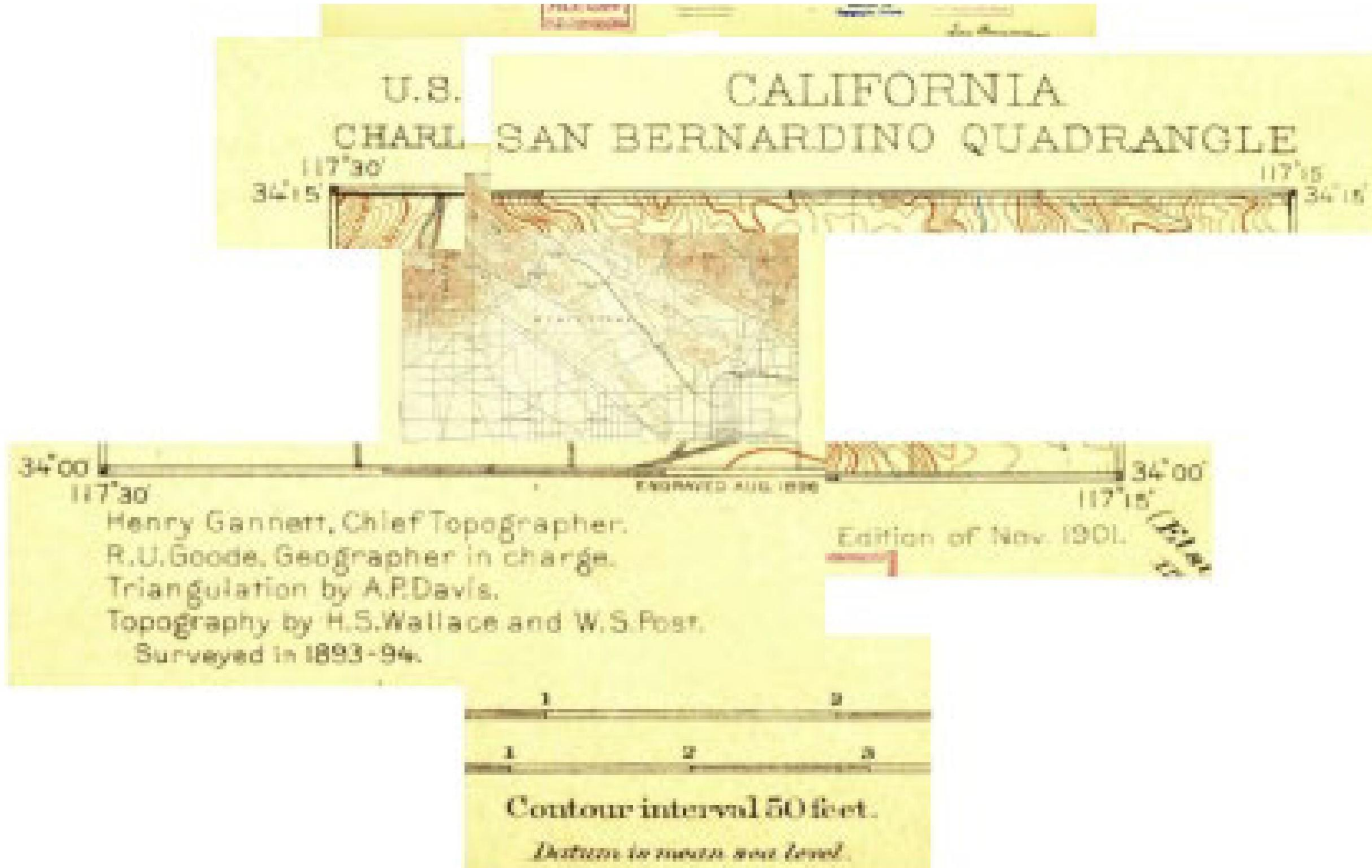
Extent of Plate 12, WSP 142





Geographic Extent of San Bernardino Quadrangle, 1:62,500, 1901 edition

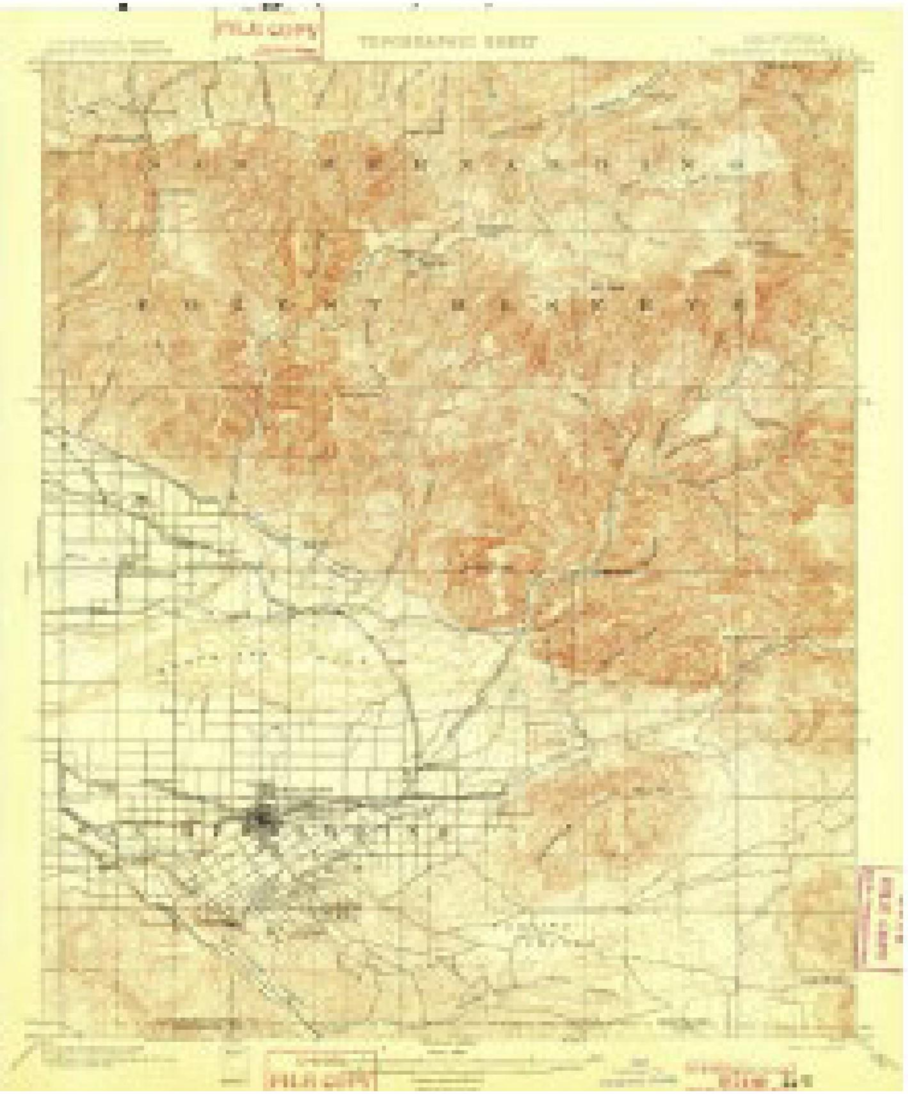


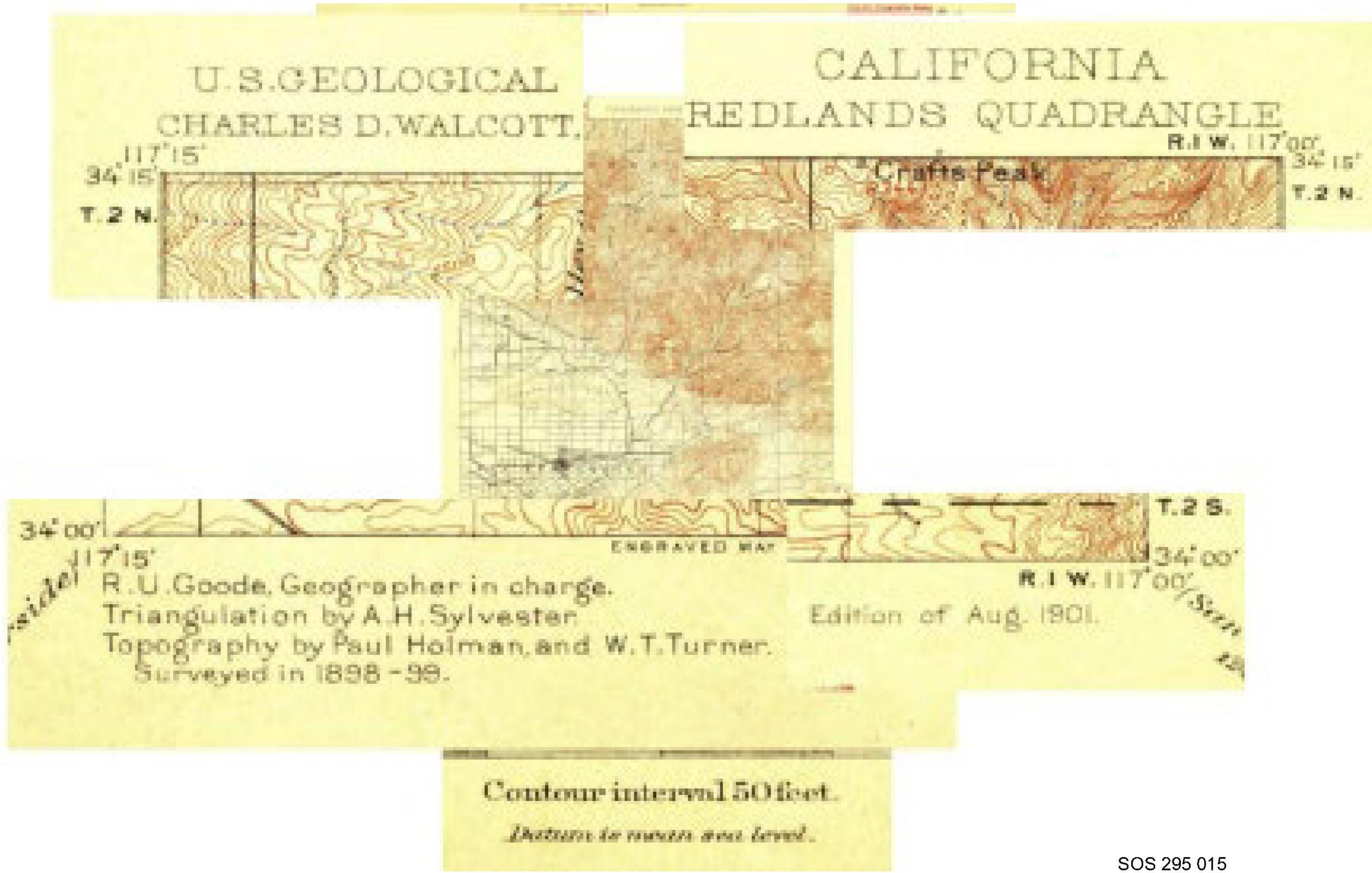


SOS 290

SOS EXHIBIT 295

Geographic Extent of Redlands Quadrangle, 1:62,500, 1901 edition





SOS 291

SOS 295 015

1893-1894/1898-1899, Survey Years, Were Drier Than Average

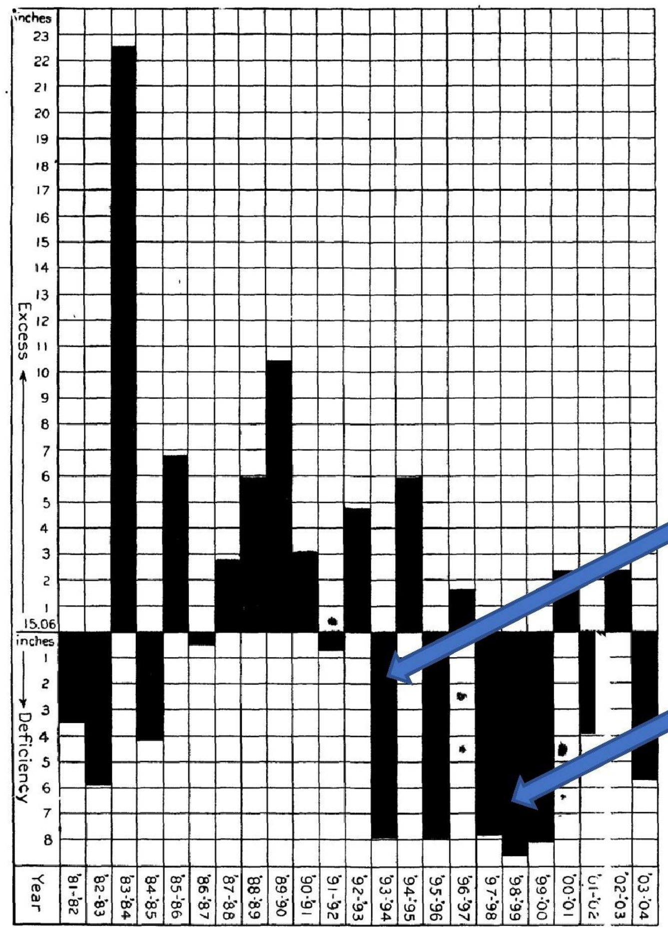


FIG. 1.—Chart showing variation from average rainfall at San Bernardino, Cal. *a*, Average for 34 years (15.06 inches).

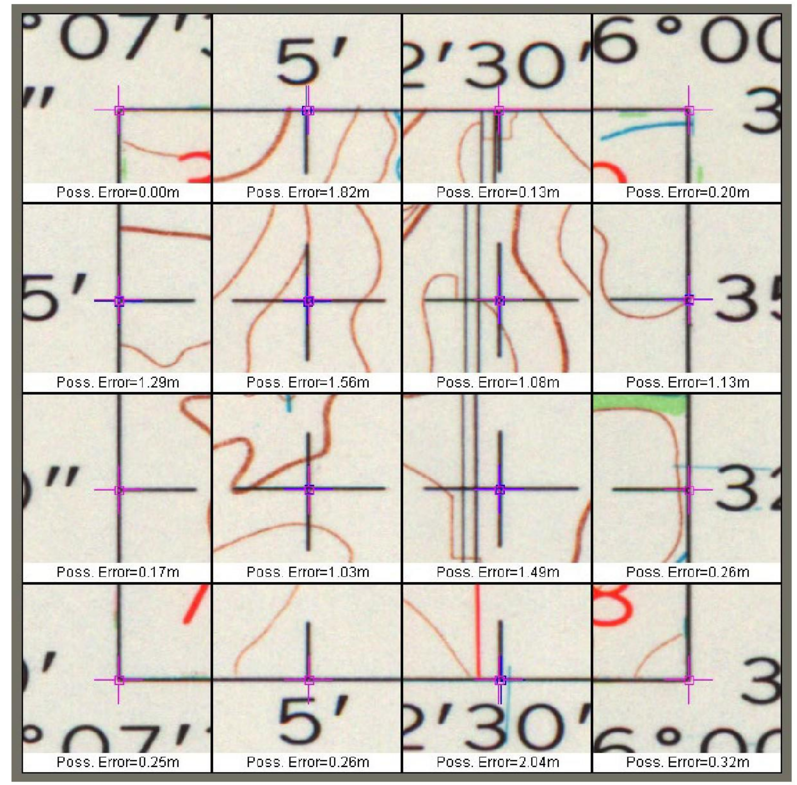
Year of surveys for San Bernardino Quadrangle (SOS 290)

Year of surveys for Redlands Quadrangle (SOS 291)

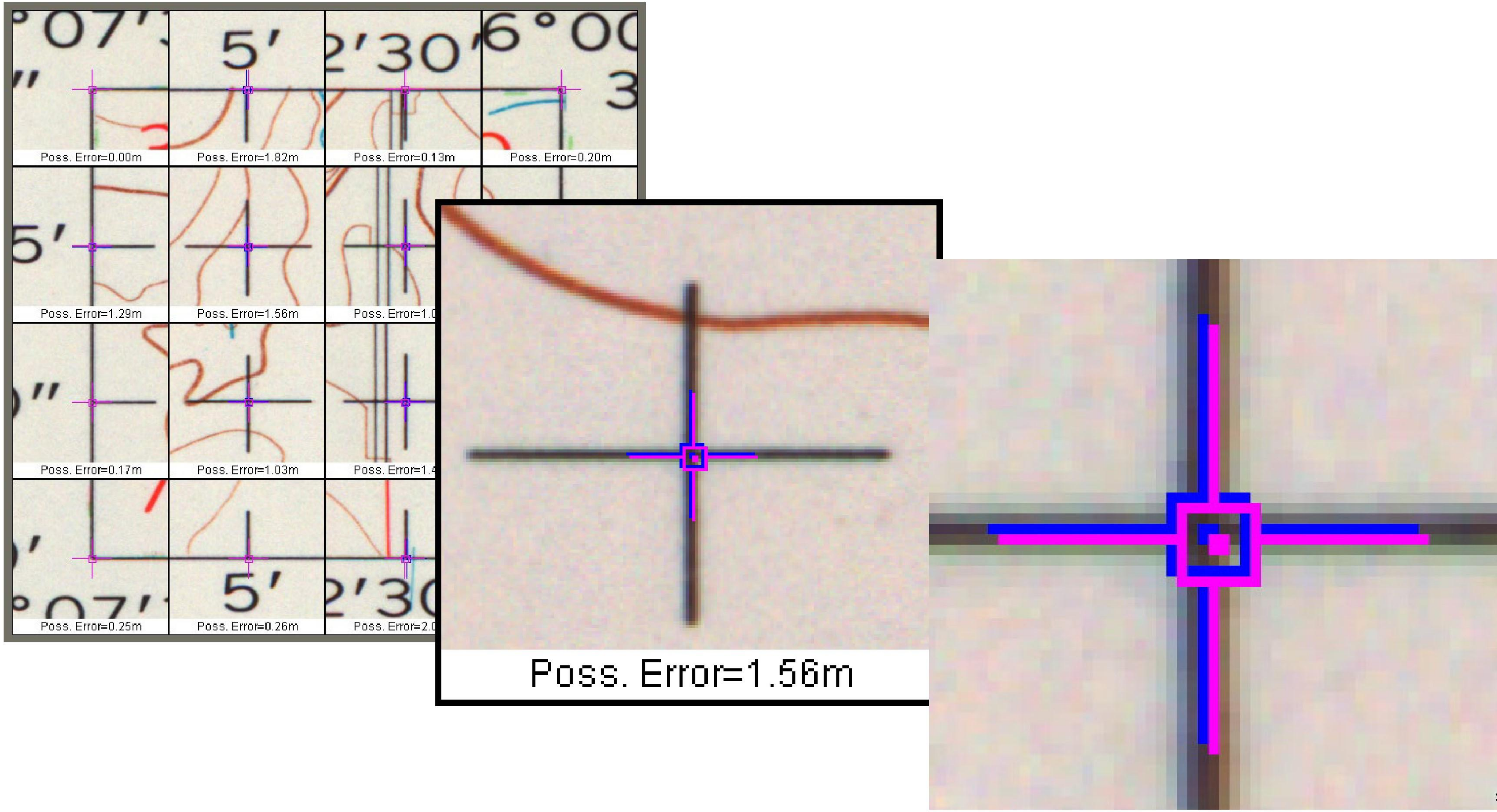
SOS 001_019 (WSP 142)

Georeferencing

Example of using 16 latitude and longitude points on a USGS quadrangle for georeferencing



Georeferencing, selecting exact center of control point is important



Opinion: Mr. Nicholls' conclusions based upon his georeferencing exercise, as described, are unreliable.

Plate Alignment

Opinion: Misalignment on Plate 12 noted by Nicholls is a result of misaligned printing plates, does not exist on the Base Map (SOS 291), and so does not suggest inaccuracies in the Base Map.

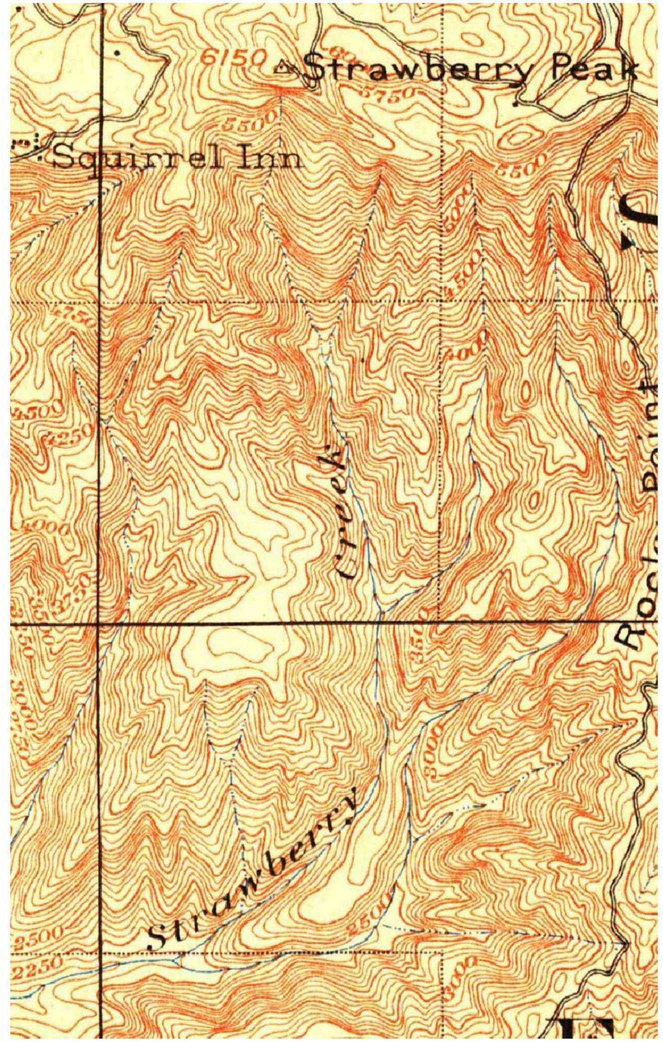
The sheets are engraved on copper, three plates being required for each.

On the first plate there is engraved the hydrography, including the coast lines, interior lakes, ponds, rivers, and, on large scale sheets, all springs and running streams. The hydrography is printed in blue.

On the second plate is delineated the hypsography — the relief of the surface. Since the accurate representation of relief is of prime importance to the geologist, great care is exercised in determining its value; and much consideration has been given to the different methods of representing this condition of the terrestrial surface. The method of representing relief by hachures has been long in vogue in this country, and brush shading has recently been employed for the same purpose to some extent; but while these devices possess the merit of producing artistic and attractive maps, they express relief only qualitatively, and are seriously affected by the personal equation of the draftsman. Contours — or grade curves — on the other hand express the relief quantitatively in terms of absolute measure. It has accordingly been decided to construct the maps in contours, and to reserve hachures and brush-shading for pictorial effect in certain special cases and for the representation of minor topographic details falling between adjacent contours. The contour-interval ranges from 10 feet in level country and upon maps of the larger scales to 200 feet in the smallest scale maps and among the high mountains of the West. (In a few maps adopted from other surveys the interval is 250 feet.) The hypsography is printed in brown.

On the third plate there are engraved the projection lines, the lettering, public culture, marginal lines, legend, title, etc. Private culture is excluded from this atlas. The distinction between »public

SOS 297_007



SOS 291

Figure 8. Copper plate engraving of topographic maps provided a permanent record.

Figure 9. U.S. Geological Survey printing presses for use of lithostones in printing topographic maps.

SOS 296_005_007